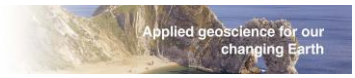
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL



Assessing the link between the Geochemistry of Soils and the Bioaccessibility of Arsenic, Chromium and Lead in the Urban Environment

Joanna Wragg and Mark Cave

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Northampton

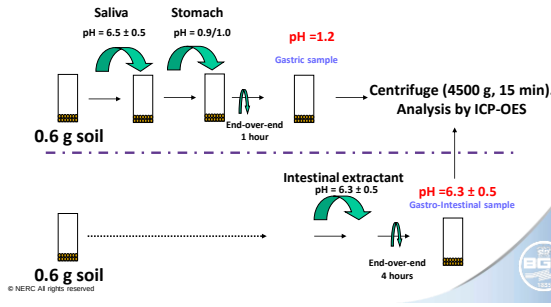
- Large Market town in central England
  - Population of c. 200,000
  - Busy Road and Rail links
- Primary industrial activities were shoe making and other leather industries
  - Now a hub for finance and distribution industries
- BGS surveyed the area as part of the G-BASE programme
- Ironstone soils, naturally elevated in arsenic
- 45% of the soils have As concentrations above the residential SGV of 32 mg mg^{-1}

What have we done?

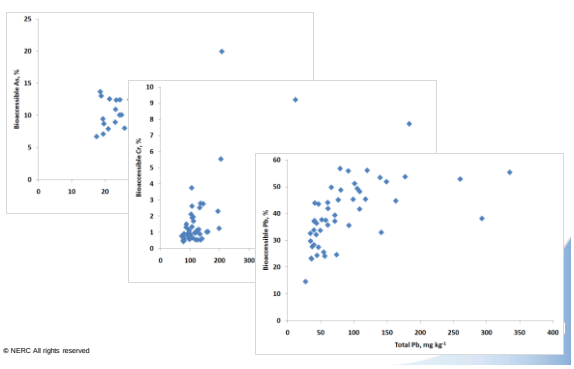
- 275 Surface soils (G-BASE Urban sampling program)
  - Composite samples
  - 5 auger flights at a depth of 10-20cm from the centre and corners of a 20 x 20m square
  - Collected from unbuilt ground every kilometre square
- XRF analysis of major and trace elements
  - All samples
- Bioaccessibility
  - Subset of 50 samples
  - Using the newly validated BARGE UBM method

Bioaccessibility

- Primary exposure route
  - Adults – 20 to 100 mg day^{-1}
  - Children – 80 to 400 mg day^{-1}



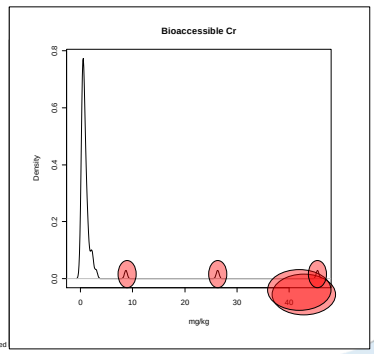
Total vs Bioaccessible PHEs



Data modelling

- Predict the bioaccessibility of PHEs using the major element geochemical data
- R
  - Density plots to identify populations in data
  - Identify and remove hotspots from the model
    - Background bioaccessibility prediction

Density plots



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  - Linear regression model based on the major element concentrations and PHE in the soils

Optimum models

	As	Cr	Pb
Intercept	**-3.036**	**-3.506**	**-11.1**
Soil pH	**5.26E-01**	**3.55E-01**	**n/a**
Na	**n/a**	**1.22E-03**	**n/a**
Mg	**2.66E-04**	**n/a**	**n/a**
Al	**n/a**	**-1.23E-05**	**n/a**
P	**8.13E-04**	**n/a**	**n/a**
Mn	**-1.15E-03**	**n/a**	**n/a**
Fe	**-2.66E-05**	**-2.04E-05**	**n/a**
As	**6.97E-02**	**n/a**	**n/a**
Cr	**n/a**	**2.35E-02**	**n/a**
Pb	**n/a**	**n/a**	**0.581**

* All coefficients significant at the 99% CI min

Data modelling

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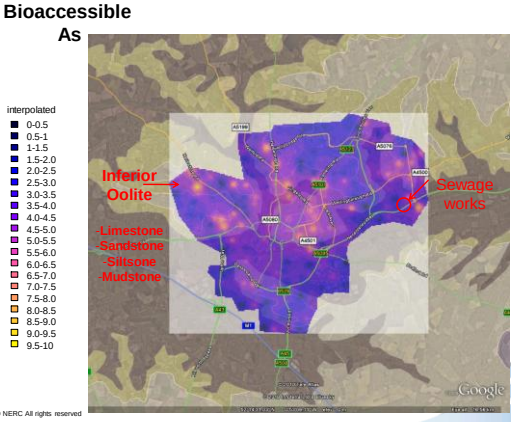
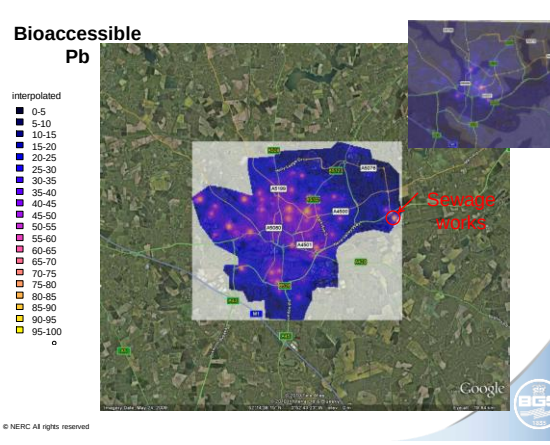
- R
  - Density plots to identify populations in data
  - Identify and remove hotspots from the model
    - Background bioaccessibility prediction
  - Linear Regression model based on the major element concentrations and PHE in the soils
  - Predict the background bioaccessibility of the whole area
  - Mapping of background bioaccessibility, even for removed hotspots (limitation)
    - As a layer in Google Earth

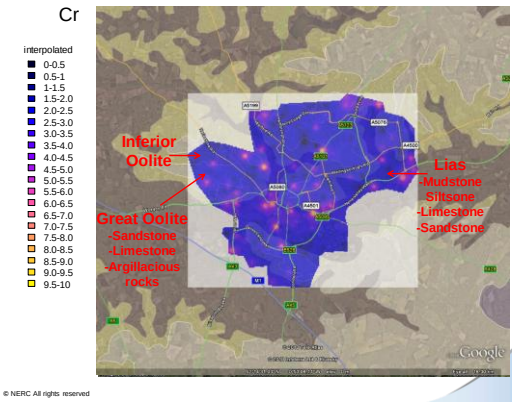
Bioaccessible As



Bioaccessible Pb



Bioaccessible Cr



Conclusions

- Possible both geogenic and anthropogenic influences on bioaccessibility of PHEs
  - As – mainly influenced by soil geochemistry – inferior oolite
  - Cr – mixed influences, background geology and possibly the previous industrial heritage of Northampton (shoemaking and tannaries)
  - Pb – see the input from the urban environment, roads, sewage works
- Looking forward
  - We have a large NIR dataset to investigate
  - Need to investigate methods to separate the geochemical controls from the anthropogenic inputs

Thankyou!